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**ANNUAL REPORT  
TO  
OFFICE OF NAVAL RESEARCH**

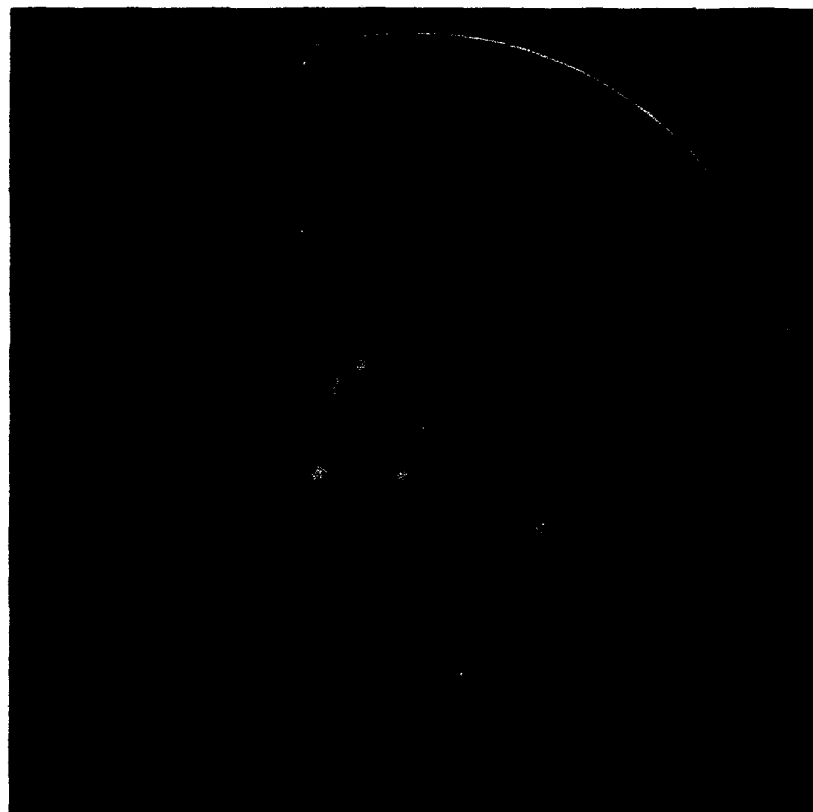
**DoD Science and Engineering Apprenticeship Program for  
High School Students**

**1993-'94 Activities  
Contract No. N00014-91-J-1825**

**Principal Manager:**

**Dr. Richard L. Pfeffer  
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The Florida State University  
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**May 1994  
The Florida State University  
Tallahassee, Florida**

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## 1. INTRODUCTION

The year 1993-'94 represented our twelfth successful DoD Science and Engineering Apprenticeship Program for High School Students, sponsored by the Office of Naval Research at Florida State University. The program this year was again administered by the Geophysical Fluid Dynamics Institute (GFDI) under the direction of Dr. Richard L. Pfeffer. Student activities were centered at GFDI and included work experience in GFDI.

Eight students were selected to work in the program starting in the summer of 1993 and six during the school year, two of whom were from the summer program. The guidance counselors of five local high schools were approached to obtain the names of outstanding college bound students. Our student group consisted of four seniors, two juniors and three exceptional sophomores. The departure from our past concentration on seniors was motivated by our desire to expose students to science and scientific methodology at an earlier age. Brief vitas of the students who were selected appear in the following section, and further information pertaining to each apprentice is attached at the end of the report.

Students spent a total of 30 hours per week with the program for 10 weeks in summer and 10-20 hours during the school year. They participated in the research program via data handling and data processing with the aid of computer operated equipment, and in enrichment activities during the summer; including lectures, laboratory demonstrations, scientific films, a formal course and a weekly discussion session on the history of science using the book *Coming of Age in the Milky Way* by Timothy Ferris. A summary of their activities and projects is included in section 3.

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## **2. STUDENTS' VITAS**

**NAME:** Joy Anderson  
**RACE:** Black  
**SEX:** Female  
**HIGH SCHOOL:** Leon High School  
**ANTICIPATED COLLEGE:** Still in High School (12<sup>th</sup> grade)  
**ANTICIPATED MAJOR:** Pharmacy  
**AWARDS/SCHOLARSHIPS:** 3 Outstanding Scholar Awards, Leon High School; 1<sup>st</sup> Place Leon High School Science Fair; 3<sup>rd</sup> Place Big Bend Regional Science and Engineering Fair  
**ACTIVITIES/HOBBIES:** Playing the Flute, Spanish Honor Club Member, MAΘ Member, Reading fiction novels, Helping Children

**NAME:** Marie F. Denis  
**RACE:** Black  
**SEX:** Female  
**HIGH SCHOOL:** Godby High School  
**ANTICIPATED COLLEGE:** Still in High School (12<sup>th</sup> grade)  
**ANTICIPATED MAJOR:** Nursing  
**ACTIVITIES/HOBBIES:** Playing Tennis and Soccer, Jogging, Dancing and Reading

**NAME:** Evaleen F. Hsieh  
**RACE:** Asian  
**SEX:** Female  
**HIGH SCHOOL:** Lincoln High School  
**ANTICIPATED COLLEGE:** Still in High School (12<sup>th</sup> grade)  
**ANTICIPATED MAJOR:** Undecided  
**AWARDS/SCHOLARSHIPS:** Various Newspaper Awards, Individual Commentary Essay Awards, Piano Auditions Award, Principal Award, (11<sup>th</sup>, GPA), English Award, Who's Who Among American High School Students  
**ACTIVITIES/HOBBIES:** Newspaper (News, Copy Editor and Co-Editor in Chief), National Honor Society (Secretary), Piano, Guitar, Oil Painting, Volunteer Work, MAΘ Math Honor Society, Writers' Exchange, Civinettes

**NAME:** Mimi Huynh  
**RACE:** Asian  
**SEX:** Female  
**HIGH SCHOOL:** Lincoln High School  
**ANTICIPATED COLLEGE:** Florida A&M University  
**ANTICIPATED MAJOR:** Pharmacy  
**AWARDS/SCHOLARSHIPS:** Lincoln High School Special Recognition Award, 1990; Lincoln National Honor Society  
**ACTIVITIES/HOBBIES:** MAΘ Member, Band, Flute Player in the Tallahassee Symphony Youth Orchestra, Reading Classics and Biographies, Creative Writing

**NAME:** Bala B. Kode  
**RACE:** Asian  
**SEX:** Male  
**HIGH SCHOOL:** Leon High School  
**ANTICIPATED COLLEGE:** Still in High School (12<sup>th</sup> grade)  
**ANTICIPATED MAJOR:** Pharmacy  
**AWARDS/SCHOLARSHIPS:** Class President in 10<sup>th</sup> grade  
**ACTIVITIES/HOBBIES:** Basketball, Football, Tennis

**NAME:** Smitha R. Pabbathi  
**RACE:** Asian  
**SEX:** Female  
**HIGH SCHOOL:** Leon High School  
**ANTICIPATED COLLEGE:** Still in High School (12<sup>th</sup> grade)  
**ANTICIPATED MAJOR:** Engineering  
**AWARDS/SCHOLARSHIPS:** National Honor Society  
**ACTIVITIES/HOBBIES:** Anchor, Latin Club, MAΘ, National Honor Society, Drawing, Reading

**NAME:** Nancy Rankin  
**RACE:** White  
**SEX:** Female  
**HIGH SCHOOL:** Godby High School  
**ANTICIPATED COLLEGE:** Still in High School (12<sup>th</sup> grade)  
**ANTICIPATED MAJOR:** Education  
**AWARDS/SCHOLARSHIPS:** Team Placed 2<sup>nd</sup> at JETS Competition, Team Placed at MAΘ Competition, 1<sup>st</sup> place at School History Fair in Dramatic Presentation Category; Cadet of the Year in ROTC During 9<sup>th</sup> grade  
**ACTIVITIES/HOBBIES:** Anchor Club Treasurer, 11<sup>th</sup> Grade; National Honor Society (Academic and Service); Brain Bowl (Academic), 10<sup>th</sup> and 11<sup>th</sup> grades; Junior Engineer Technical Society (JETS) Academic Competition Sponsored by FAMU/FSU School of Engineering; JROTC (Service and Academic); Member of Drill Team and Kitty Hawk; President of Kitty Hawk, 9<sup>th</sup> through 11<sup>th</sup> Grades; Spanish Club Honor Society (Academic and Service), 9<sup>th</sup> and 10<sup>th</sup> Grades; History Fair

**NAME:** Theophilus J. Rose  
**RACE:** Black  
**SEX:** Male  
**HIGH SCHOOL:** Florida High School  
**ANTICIPATED COLLEGE:** Still in High School (10<sup>th</sup> grade)  
**ANTICIPATED MAJOR:** Law  
**AWARDS/SCHOLARSHIPS:** Honor Roll throughout high school  
**ACTIVITIES/HOBBIES:** Basketball

**NAME:** Nathan Rychlik  
**RACE:** White  
**SEX:** Male  
**HIGH SCHOOL:** Florida High School  
**ANTICIPATED COLLEGE:** Still in High School (10<sup>th</sup> grade)  
**ANTICIPATED MAJOR:** Undecided

**NAME:** Michael Towns  
**RACE:** White  
**SEX:** Male  
**HIGH SCHOOL:** Florida High School  
**ANTICIPATED COLLEGE:** Brigham Young University  
**ANTICIPATED MAJOR:** Undecided  
**AWARDS/SCHOLARSHIPS:** Member of Gifted Student Program for 3 years; Accepted in Advanced Placement (AP) Program for Junior Year; Student of the Month at Merritt Brown Middle School; Scripture Scholar Award in Seminary  
**ACTIVITIES/HOBBIES:** Reading, Participant in the D. A. R. E. Program; Boy Scouts of America, Life Scout

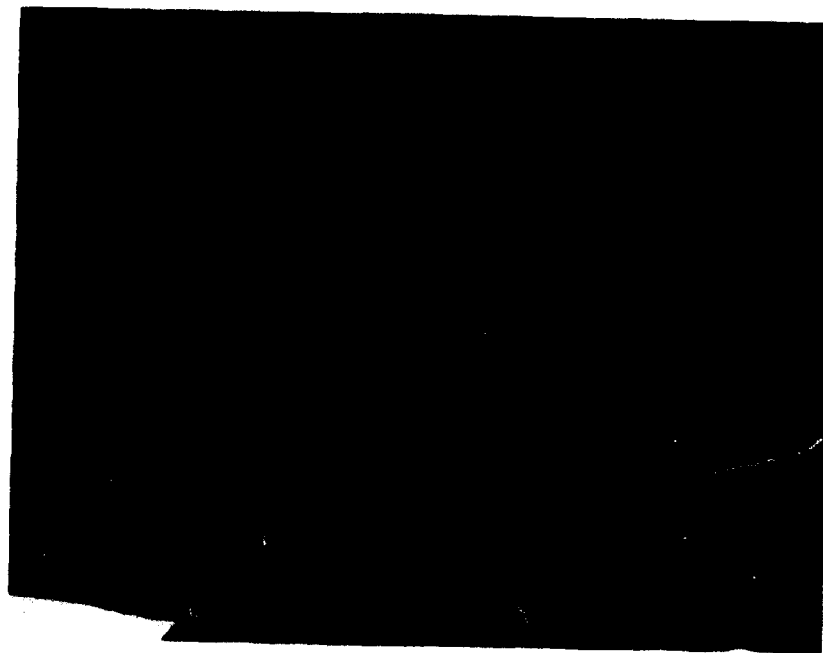
**NAME:** Abigail Warren  
**RACE:** White  
**SEX:** Female  
**HIGH SCHOOL:** Lincoln High School  
**ANTICIPATED COLLEGE:** Still in High School (12<sup>th</sup> grade)  
**ANTICIPATED MAJOR:** Botany or Genetic Engineering  
**AWARDS/SCHOLARSHIPS:** 1<sup>st</sup> Place State History Fair; 9<sup>th</sup> Place National History Day (Historical Paper Division); 4<sup>th</sup> Place Calculus Team Member (MAΘ Math Regional Competition); Undergraduate Awards for Math, Science and English; 3<sup>rd</sup> Place Pre-calculus Team Member (MAΘ National Competition); Who's Who Among American High School Students (3 years)  
**ACTIVITIES/HOBBIES:** MAΘ Math Honor Society, National Honor Society, German Club, Writers' Exchange, Marching and Symphonic Bands, Writing, Drawing, Reading, Sewing, Gardening

**NAME:** Toni Williams  
**RACE:** Black  
**SEX:** Female  
**HIGH SCHOOL:** Godby High School  
**ANTICIPATED COLLEGE:** Florida A&M University  
**ANTICIPATED MAJOR:** Nursing  
**AWARDS/SCHOLARSHIPS:** Who's Who Among American High School Students, French Honor Society, High Honor Roll; Two Academic Letters and an Academic Bar  
**ACTIVITIES/HOBBIES:** Dancing

### **3. STUDENT WORK PROJECTS**

The students participated in digitizing velocity vector data from photographs of flow fields obtained in laboratory experiments that simulate the influence of mountains on the atmospheric jet stream. This activity was a part of a larger project on studies of the interaction of bottom topography with overlying baroclinic waves investigated by Drs. R. L. Pfeffer and R. Kung. The students' work was supervised by Mr. Eugene Arbogast and assisted by Messrs. Mike Ivey and Lester Joe Dennis.

The major project in which the students participated during the summer was the analysis of photographic velocity data from laboratory experiments on the interaction of topography with baroclinic waves, and flows with azimuthally varying lower thermal boundary conditions. The experiments were conducted in a thermally driven rotating annulus of fluid.



**Dr. Robin Kung Demonstrates the Laser Annulus to T. J. Rose and Nathan Rychik**





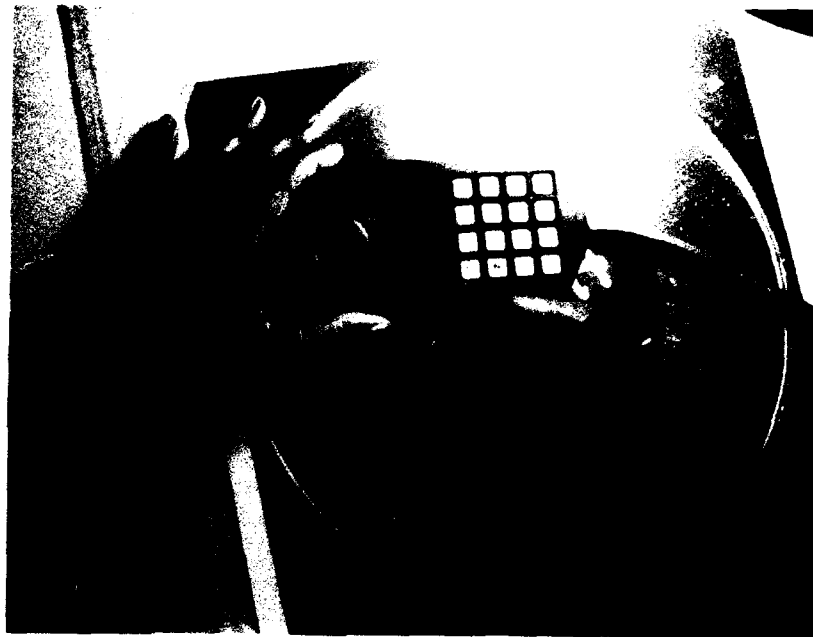
#### Prof. Paul Elliott Lectures on Contagious Viruses

The data from the experiments were obtained by means of a camera, mounted at the top of a rotating annulus of fluid, which recorded the movements of laser-illuminated particles suspended in the fluid. The camera produced a sequence of still photographs; in each photograph the movement of every particle appeared as a string of dots. By digitizing the positions of these dots and calculating the distance between dots and the orientation of each string of dots, one can determine the velocity field as a function of time. Fourier analyses and energetics calculations of such data provide valuable information about the behavior of baroclinic fluids in the presence of bottom topography.

The students had the opportunity to gain experience in the use of digitizing equipment, personal computers, and video monitors which display the work graphically as it is being digitized. They were also able to see and discuss the results of a first-level analysis of the digitized data produced with the DEC VAX computer cluster. During the course of the summer, the students worked with the photographs from several different experiments, which allowed them to see effects of variations in experimental

parameters such as the difference in temperature between the inner and outer walls of the bath, the speed of rotation, and the presence or absence of topography.

Efforts were made to ensure the students' understanding of the relationships between the theoretical model and observable phenomena, such as the jet stream and ocean currents, which affect the transfer of energy between the earth's equator and poles.



T. J. Rose Digitizes a Photo

#### 4. INSTRUCTION AND ENRICHMENT ACTIVITIES

The instruction and training received by the students concerning their work assignments always went beyond that needed to do the job. An attempt was made to make their work experience a learning process and an introduction to scientific research. An explanation of the research project, its implications, and the contribution of the students' work to the overall project was given.

Aside from the students' activities as apprentices, a variety of other educational activities were scheduled. These included a series of talks on research topics covering a broad spectrum of scientific

disciplines. Talks were given by Drs. Albright, Blumsack, Cekirge, Elliott, Elsner, Furbish, Gilmer, Gruender, Howard, Ruby Krishnamurti, Kung, Long, and Nicholson on topics ranging from the prediction of the trajectories of oil spilled in coastal waters to Immunology and the HIV virus. In addition to these, the students engaged in discussions with Dr. Long on the *Coming of Age in the Milky Way*, an exciting book on the history of science by Timothy Ferris. A series of scientific films was also selected and shown by Dr. Kung. These covered topics such as astronomy, evolution, the structure of matter, relativity, space, the oceans and others. Drs. Kung and Krishnamurti also engaged the students in a series of scientific experiments in which different natural phenomena were simulated in the laboratory. A list of these activities is given in Table 1.

The students also took advantage of another opportunity offered by the program — namely a course of their choice, with tuition and books paid for by the program. They took a Meteorology course given by Mr. Chris Herbster and were given the same homework assignments and exams as the regular college students.

## 5. CONCLUSION

Questionnaires completed at the end of the summer program of enrichment activities revealed that the students felt that, aside from the monetary rewards, they had benefited a great deal from both the hands on work experience and the enrichment program. This was especially true of the younger students. They were grateful for the opportunity to work in a scientific environment and acquire new skills and experience. Faculty and staff mentors reported that the students were bright, attentive, well motivated and willing to work. Their contribution to the various projects was also significant. The digitizing work was done carefully and accurately and hence contributed substantially to a much needed data base for further analysis and study.

In general, the students felt financially rewarded and scientifically enriched by their experience in the program. We feel that the students acquired a certain maturity and confidence which should be a great asset to them during their final years in high school, college and their chosen careers.

# 1993 G.F.D.I. Summer Program Enrichment Schedule

Time: 11:00 am to 12:00 noon: Place: GFDI Reading Room or as indicated

<b>Monday Films</b>	<b>Tuesday Lab. Demonstration</b>	<b>Wednesday Discussions**</b>	<b>Thursday Talks</b>
<b>June 7 (V70492)</b> <i>The Shores of the Cosmic Ocean</i> (COSMOS Episode 1)	<b>8</b> <b>Robin Kung</b> <i>Lab. Experiments at GFDI</i>	<b>9</b> <b>Christopher Long</b> <i>The Dome of Heaven</i>	<b>10</b> <b>Paul Elliott</b> <i>Immunology and the HIV Virus</i>
<b>14 (V70493)</b> <i>The Harmony of the Worlds</i> (COSMOS Episode 3)	<b>15</b> <b>Robin Kung</b> <i>Annulus Experiments</i>	<b>16</b> <b>Christopher Long</b> <i>Raising the Roof</i>	<b>17</b> <b>Louis Howard</b> <i>When Does the Sun Set?</i>
<b>21 (V70495)</b> <i>The Backbone of Night</i> (COSMOS Episode 7)	<b>22 (Discussion)</b> <b>Christopher Long</b> <i>Deep Space</i> <i>The Discovery of the Earth</i>	<b>23 (Lab.Demo.)</b> <b>George Buzyna</b> (at M.E. Lab.) <i>Supersonic Flow</i>	<b>24</b> <b>Steve Blumsack</b> <i>Discrete Dynamical System</i>
<b>28 (V70498)</b> <i>Who Speaks for Earth</i> (COSMOS Episode 13)	<b>29</b> <b>Ruby Krishnamurti</b> <i>Rayleigh-Benard Convection</i>	<b>30</b> <b>Christopher Long</b> <i>The Sun Worshippers</i>	<b>July 1</b> <b>Sharon Nicholson</b> <i>The Earth as a System- An Example from Namib Desert</i>
<b>5</b> <b>Holiday</b>	<b>6</b> <b>Ruby Krishnamurti</b> <i>Double-Diffusive Instability</i>	<b>7</b> <b>Christopher Long</b> <i>The World in Retrograde</i>	<b>8</b> <b>David Gruender</b> <i>The Trial of Galileo</i>
<b>12 (V70306)</b> <i>Strange New Science of Chaos</i> (NOVA)	<b>13</b> <b>Ruby Krishnamurti</b> <i>Thermal Oscillators</i>	<b>14</b> <b>Christopher Long</b> <i>Newton's Reach</i>	<b>15</b> <b>David Furbish</b> <i>Ocean Tides, Atmospheric Pressure and Ground Water Flow</i>
<b>19 (F382460)</b> <i>Distance Voice</i> (Connection 3)	<b>20</b> <b>Chiang Shih</b> (at M.E. Lab.) <i>Velocity Measurements by Partial Image Method</i>	<b>21</b> <b>Christopher Long</b> <i>A Plumb Line to the Sun</i>	<b>22</b> <b>John Albright</b> <i>Scientific Achievement of P.M. Dirac</i>
<b>26 (F382470)</b> <i>Faith in Numbers</i> (Connection 4)	<b>27</b> <b>Robin Kung</b> <i>Rotating Fluid Flow</i>	<b>28</b> <b>Christopher Long</b> <i>Deep Space</i>	<b>29</b> <b>Penny Gilmer</b> <i>Modulation of Immune Recognition of Tumor Cells</i>
<b>August 2 (F382490)</b> <i>Thunder in the Skies</i> (Connection 6)	<b>3</b> <b>Ruby Krishnamurti</b> <i>Mixing and Unmixing</i>	<b>4</b> <b>Christopher Long</b> <i>Island Universes</i>	<b>5</b> <b>Jim Elsner</b> <i>How Predictable is the Weather</i>
<b>9 (F382530)</b> <i>Yesterday, Tomorrow and You</i> (Connections 10)	<b>10</b> <b>Robin Kung</b> <i>Temperature Calibration</i>	<b>11</b> <b>Christopher Long</b> <i>Einstein's Sky</i>	<b>12</b> <b>H. M. Cekirge</b> <i>Oil Spills</i>

\*\* Chapter by chapter discussion of "Coming of Age in the Milky Way" by Timothy Ferris, Anchor Books, 1988.



**Nancy Rankin Digitizes a Photograph from the Laser Annulus**



**Nathan Rychlik Develops Laser Annulus Photos in GFDI's Dark Room**